

Sections II and III should provide adequate information for you to understand all the synthesizer's controls and functions. You need not read this section to know how to play your synthesizer. However, Section IV does offer alternative and more comprehensive explanations for the benefit of experienced synthesists.

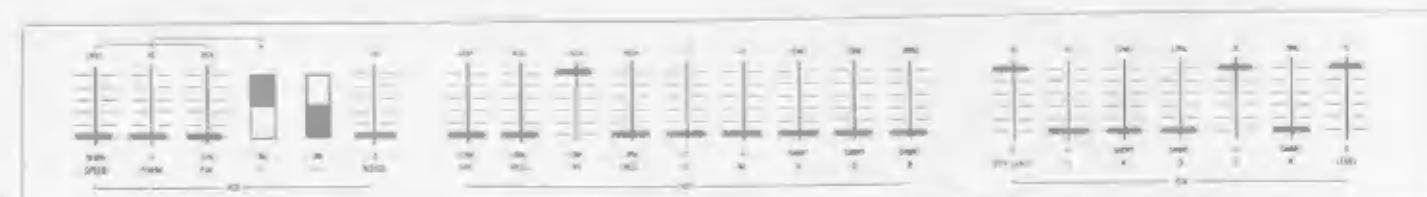
#### Overall Picture

The CS-50 is a four note polyphonic synthesizer; the CS-60 an eight-note. Thus you can play chords, not merely a single note at a time. On the CS-60, there are twelve factory preset patches, one programmable panel and one miniature version of the panel that serves as a memory for any additional voice you wish to store. The CS-50 has an extra preset instead of the memory panel. Thus, when you have programmed the panel (and memory on the CS-60), you can select from 14 different sounds at the touch of a finger.

#### The Programmable Panel

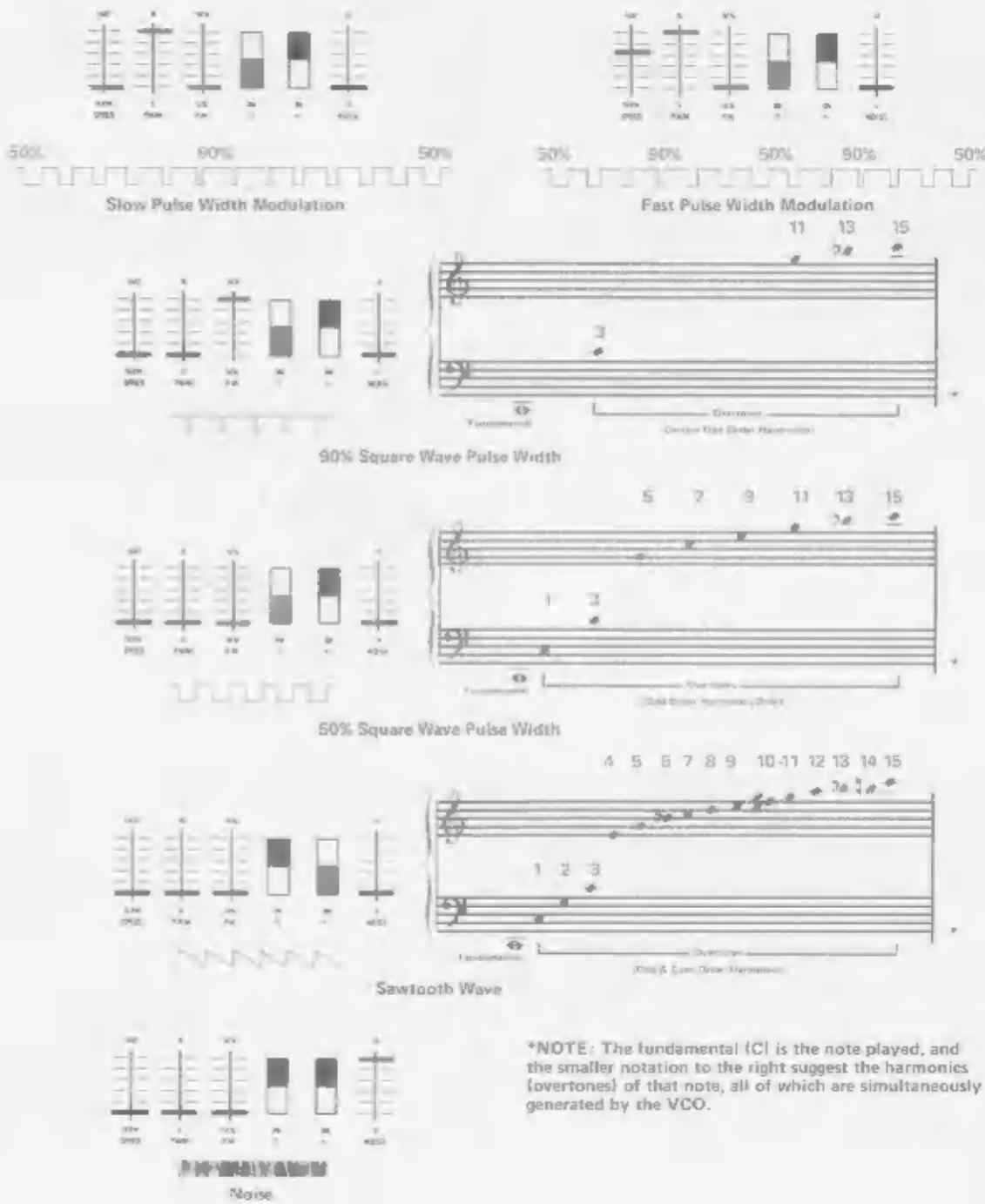
If you wish to hear what the PANEL controls do as you read about them, press the PANEL button on the Tone Selector [3], turn up the Volume [2], and be sure the Foot Controller (expression pedal) is flat (maximum volume).

**NOTE:** Before starting, it is advisable to set all other controls at their nominal positions, as shown, because many controls and functions are interrelated.

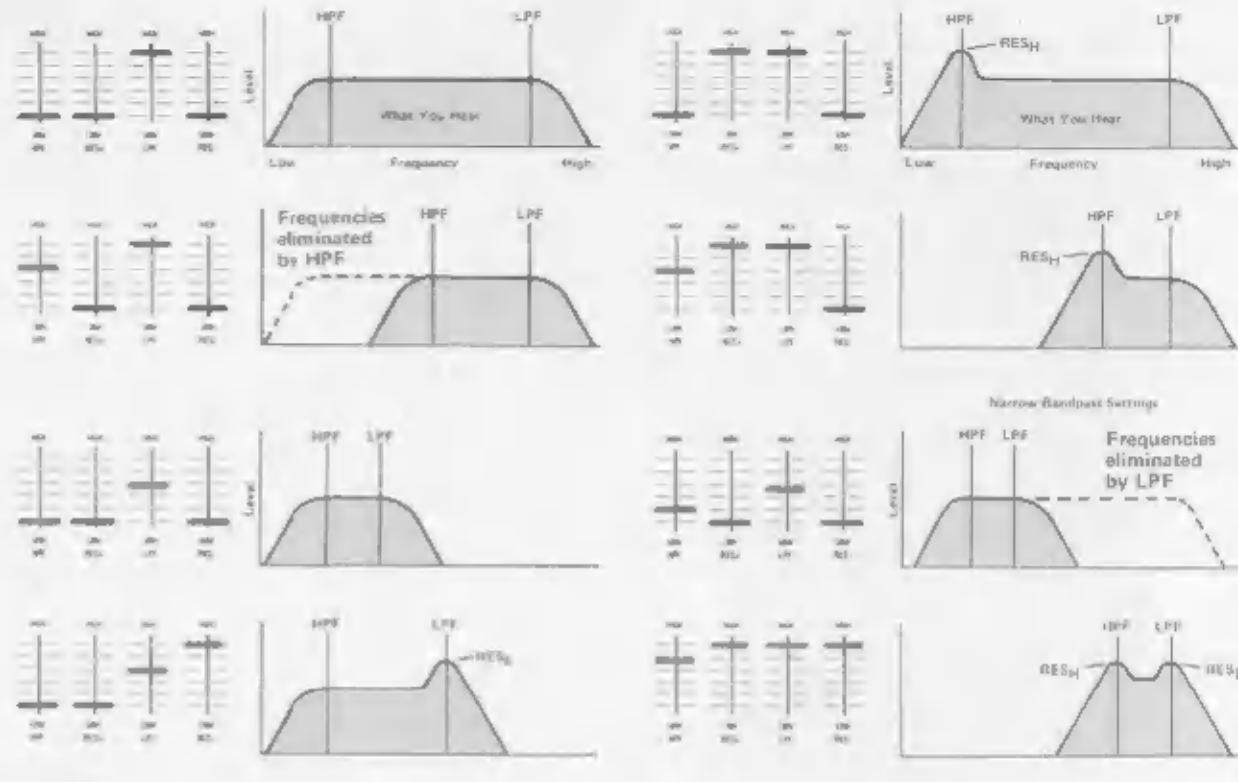


### VCO (Voltage Controlled Oscillator)

- [15] SPEED – Adjusts the rate of pulse width modulation of the square wave, provided the PWM lever is moved away from its "0" position.
- [16] PWM – Adjusts the depth of Pulse Width Modulation (the deviation in square wave duty cycle). A "0" setting yields no modulation.
- [17] PW – Sets the basic duty cycle of the square wave from a symmetrical wave (50%) to a narrow pulse (90%).
- [18] SQUARE WAVE – Turns ON the square wave generating circuits when the switch is rocked forward.
- [19] SAWTOOTH WAVE – Turns ON the sawtooth wave generating circuits when the switch is rocked forward.
- [20] NOISE – Introduces white noise into the VCO output as the slider is moved up (#10 is maximum noise).



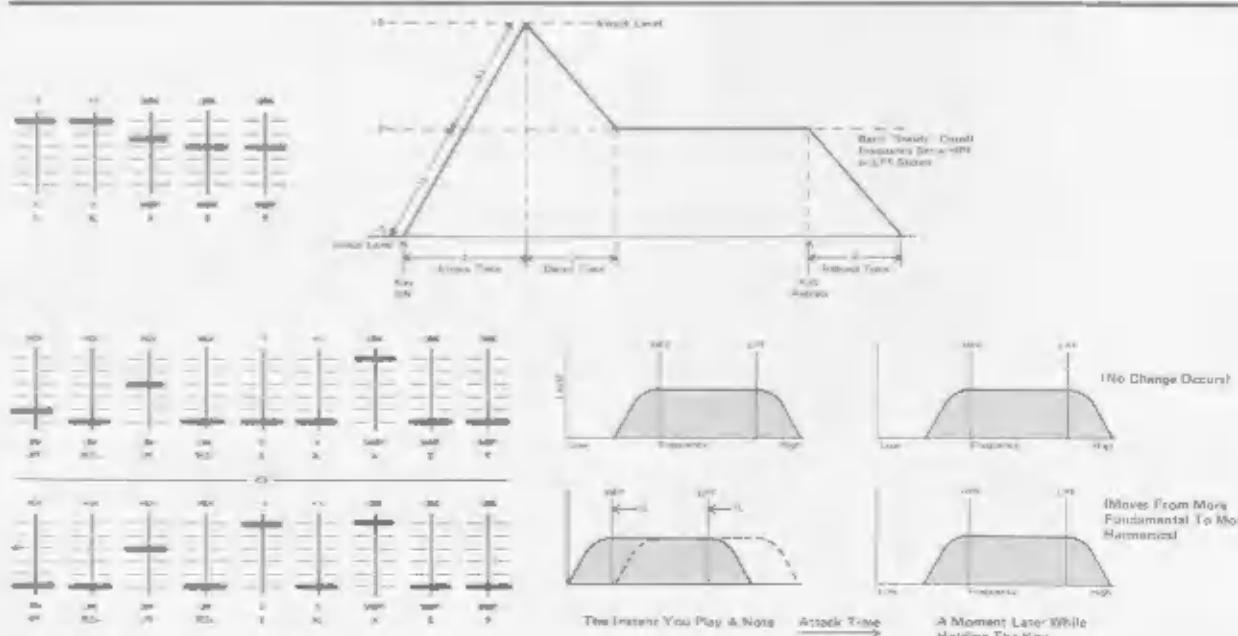
[21] **HPF** – Sets the cutoff point of the High Pass Filter (low cut filter). With the slider at **LOW**, the cutoff frequency is lowest (filter wide open), and at **HIGH**, the cutoff frequency is highest (filter closed).



#### VCF Envelope Generator

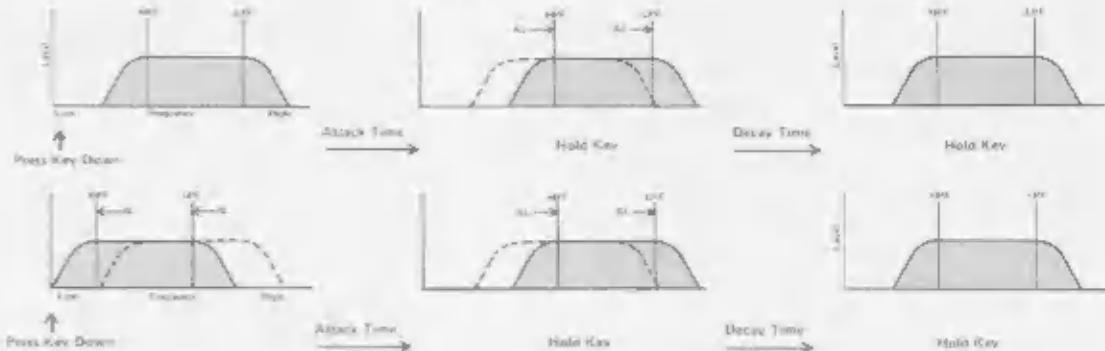
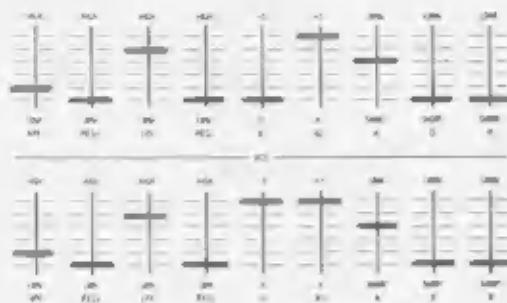
NOTE: Yamaha's filter envelope generator, with "IL-AL-A-D-R," is unique among synthesizers.

[25] **IL** – {Initial Level} Lowers the initial filter cutoff points of the high pass and low pass filters, when a note is first played, relative to the "steady" levels set with the HPF and LPF sliders. Moving IL up toward "-5" is like starting with HPF and LPF lower than their sustained cutoff points and then moving them together to their sustained levels.

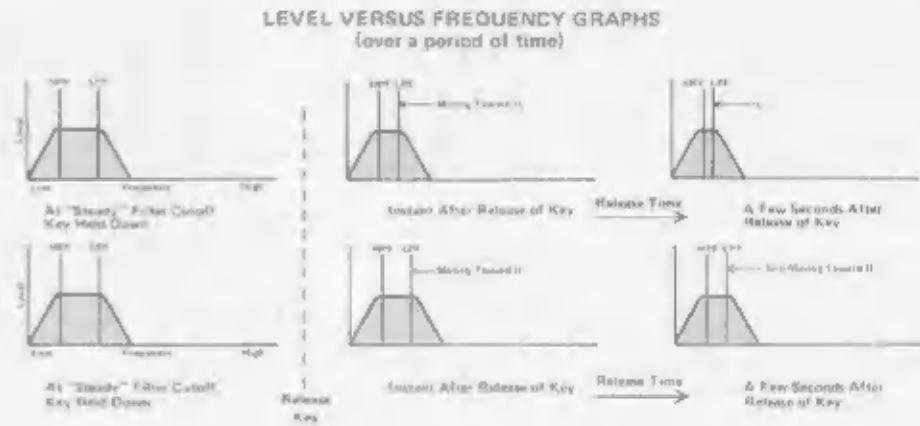
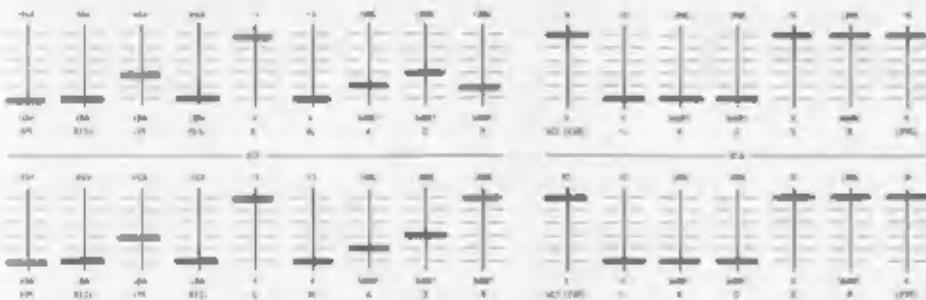


[26] **AL** – {Attack Level} Raises the filter cutoff points when a note is first played. The AL rise occurs while you hold a note down, beginning from the "steady" cutoffs set with the HPF and LPF sliders, going to the maximum set with AL, and then returning to the "steady" cutoffs.

[27] **A** – {Attack Time} Adjusts the time it takes for the filters to move from the minimum IL to the maximum AL cutoff frequencies when either or both of these sliders are moved up from "0". Attack Time has no effect if IL and AL are both at "0."



Reset VCA so you can hear these effects better.



[28] **D** – {Decay Time} Adjusts the time it takes for the filters to move from the maximum AL cutoff point back to the sustained level. Decay Time has no effect if AL is at "0."

[29] **R** – {Release Time} Adjusts how long it takes for the filters to return to the set IL frequency cutoff points after the key is released. With no IL and AL, Release Time has no effect. If IL is set at "0," but AL is provided, the Release Time setting may have an effect, depending on how fast the attack and decay times are and whether you release a key before the filters have already settled in to their sustained cutoffs. (NOTE: In any event, you cannot hear the effect of this Release Time slider unless the VCA Release Time [35] is relatively long also, or unless a long Sustain is provided by the Sustain section [10].

Play a series of rapid staccato notes and several long chords for each of these patches.

NOTE: In the lower illustrations, the HPF slider is wide open, so the lower filter cutoff (shown by the HPF lines) cannot move any lower. Therefore, only the upper cutoff (shown by the LPF lines) moves, at the rate of motion being determined by the release time.

From left to right the graphs are only a few samples of filter characteristics at specific times: relative to release of the key. The filter changes actually occur gradually.

## VCA (Voltage Controlled Amplifier)

[30] **VCF LEVEL** — Adjusts the amount of input to the VCA provided by the VCO's square wave, sawtooth wave and/or noise generators and filtered by the VCF.

[31] **SINE WAVE LEVEL** — Adjusts the amount of input to the VCA provided by the VCO's sine wave generator. Since the sine wave does not go through the VCF, it may be mixed in any proportion with the VCF-processed signals as it enters the VCA.

[32] **A** — (Attack Time) Adjusts how long it takes for the level to increase to a maximum each time a note is played.

[33] **D** — (Decay Time) Adjusts how long it takes for the level to decrease from a maximum to a steady (sustained) level each time a note is played.

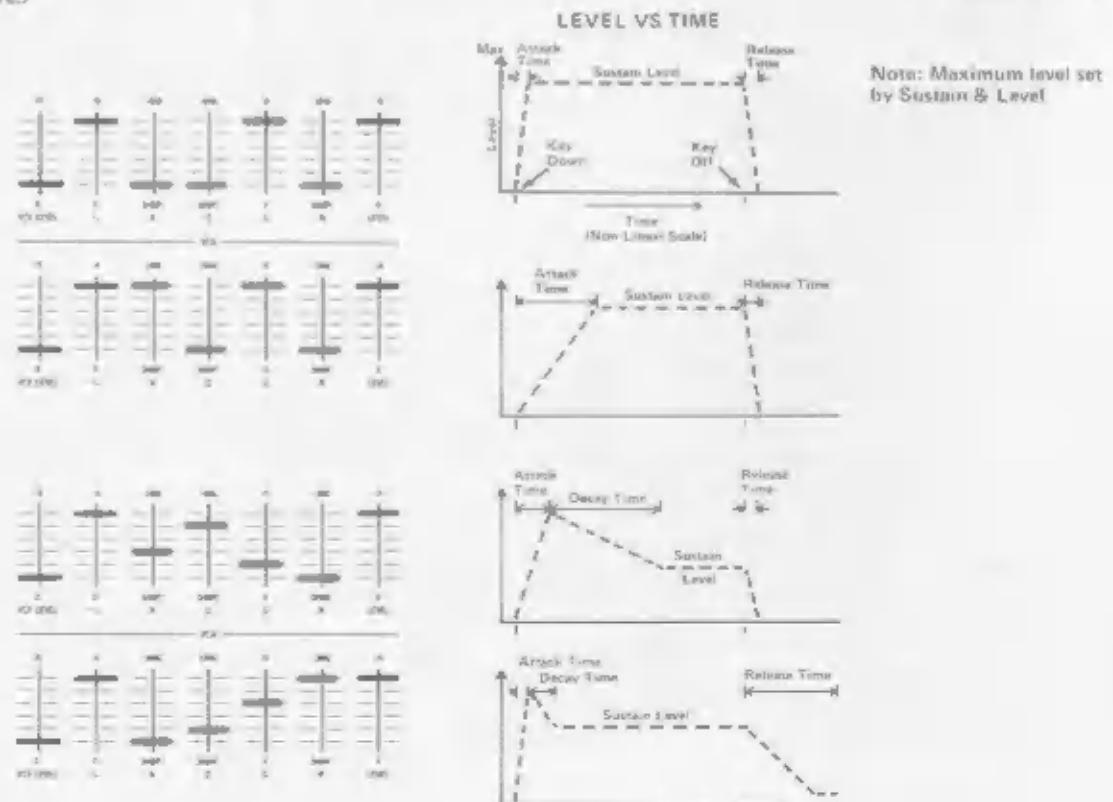
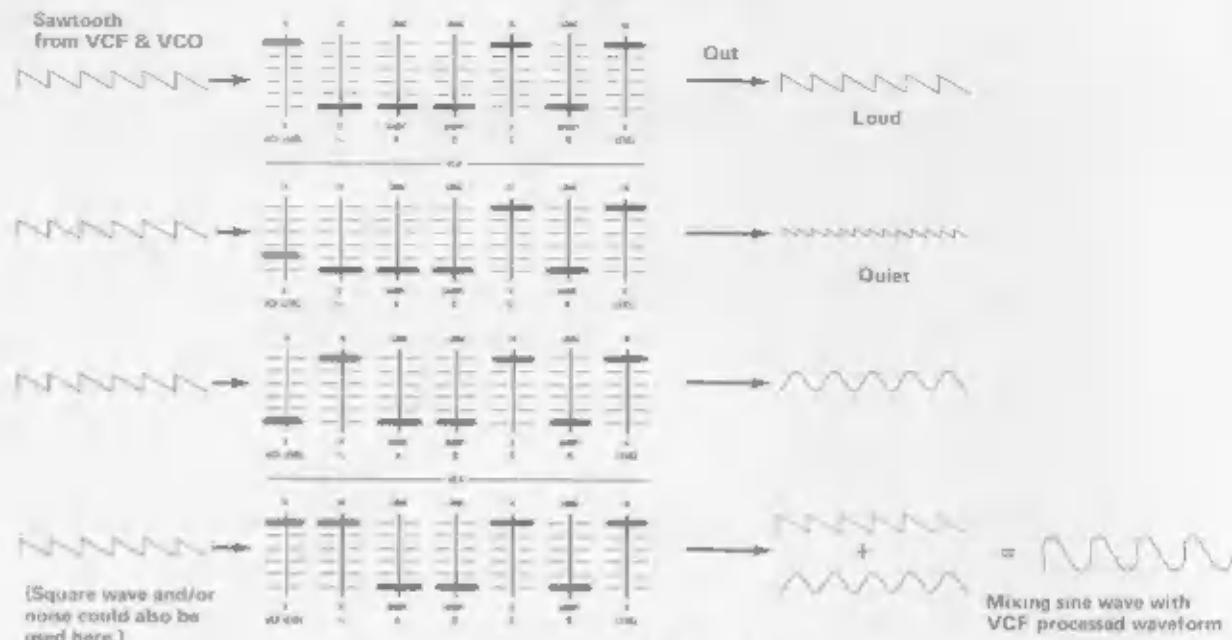
[34] **S** — (Sustain Level) Adjusts the fixed level of a note that is steady (after attack and decay) so long as a key is held down.

[35] **R** — (Release Time) Adjusts how long it takes for the level to die to silence after you release a key. The effect is like the sustain time provided by the controls in [10].

[36] **LEVEL** — (VCA Level) Sets the highest level attained by the VCA, thus affecting the sustain level and the maximum attack level. If VCF LEVEL [30] and SINE WAVE LEVEL [31] are thought of as input mixing controls, then this slider serves as the VCA's master output control.



[37] **MEMORY (CS-60 ONLY)** — A miniaturized version of the same controls found in the Programmable Panel may be used to patch an additional sound or to keep a favorite patch protected from accidental lever movements. To hear the Memory, press the Memory Tone Selector [3]. You can transfer patches from PANEL to MEMORY by eye, and then "fine tune" the memory by ear.

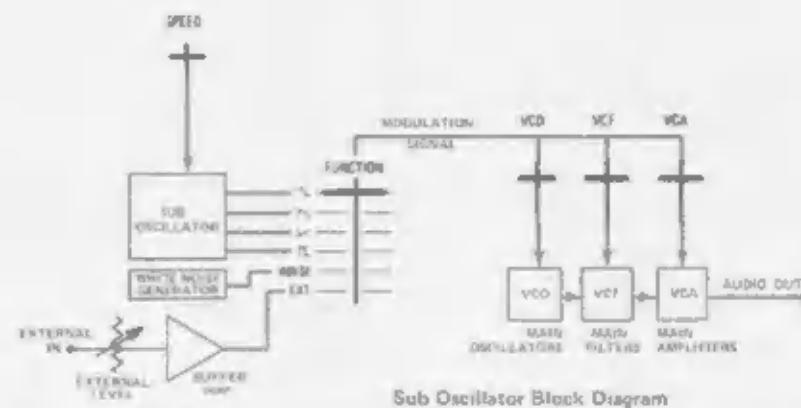


### Other Selectors & Sound Modifiers

[13] **PITCH** — Tunes the entire keyboard. The outer ring is a coarse adjustment, the inner ring a fine adjustment. Center both controls for "normal" pitch.

[12] **RING MODULATOR** — MODULATION is a depth of effect control. SPEED set the modulation rate. ATTACK TIME & DECAY TIME serve as an attack-release envelope for the ring modulation speed. DEPTH sets the amount of envelope effect.

[8] **SUB OSCILLATOR** — FUNCTION selects a waveform: sine, sawtooth, inverted sawtooth, square wave, white noise, or an external input. (A line level signal connected to the Ext In jack on the rear panel will modulate the Sub Oscillator in EXT mode.) SPEED sets the frequency of the sine, sawtooth or square wave. VCO, VCF and VCA are modulation depth controls that apply the selected signal to the control inputs of their respective voltage controlled circuits (oscillator, filter and/or amplifier).



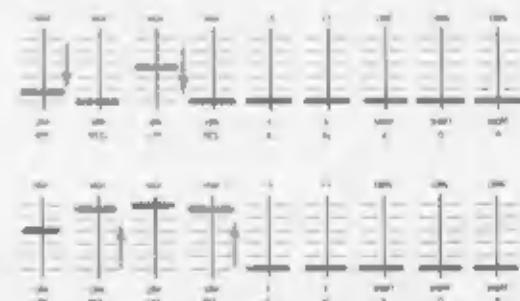
[5] **BRILLIANCE** — Adds voltage to the VCF's high pass and low pass control inputs, thus shifting up the cutoff frequencies and brightening the sound as the lever is pulled down. Nominal setting is centered, but there is a considerable change in sound when you adjust this for different patches.

[6] **RESONANCE** — Adds voltage to the VCF's resonance control inputs, thus increasing the resonance and adding twang as the lever is pulled down. The lever is up for its nominal setting, providing minimum additional resonance.

[3] **TONE SELECTOR** — Push down any one of these switches to select the voice you want, whether a preset patch, panel-programmed patch (or memory-programmed patch on the CS-60). The buttons have automatic releases so only one voice at a time can be selected; if two or more TONE SELECTOR buttons are pressed down simultaneously, only the one closest to the right side of the instrument will be heard. (Preset sound quality depends largely on the setting of the BRILLIANCE lever [5].)



Moving Brilliance Up (minimum) is like moving HPF & LPF Down (& vice-versa) for preset or programmed patches.



Moving Resonance Down (maximum) is like moving RES<sub>H</sub> & RES<sub>L</sub> Up for preset or programmed patches.

[4] **TRANSPOSITION** – Push down these switches to shift the frequency range of the entire instrument 1 OCTAVE DOWN, 2 OCTAVES DOWN, or 1 OCTAVE UP from the NORMAL pitch range. When the NORMAL button is down, and the PITCH controls [13] are centered, middle C on the keyboard is true middle C. The buttons have automatic releases so only one pitch range at a time can be selected; if two or more TRANSPOSITION buttons are pressed down simultaneously, the instrument will play in the highest pitch range selected.

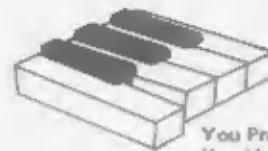
[9] **TOUCH RESPONSE** – VCO and VCF do the same thing as their counterparts in the Sub Oscillator section [8], using its set FUNCTION and basic SPEED. However, these levers make the keyboard pressure sensitive so the farther down you pull a lever and the harder you press a key after it hits bottom, and the more effect. BRILLIANCE does the same thing as the main BRILLIANCE lever [5], and LEVEL the same thing as the VOLUME control [2], but again, they only add effects when one or more keys is pressed down harder after hitting bottom.

[7] **KEYBOARD CONTROL—BRILLIANCE (CS-60 ONLY)** – The LOW and HIGH levers separately adjust the brilliance of the lower and upper sections of the keyboard (by subtracting from or adding to the voltage applied to the HPF and LPF control inputs in the VCF). Instead of a “split keyboard,” the levers gradually add or subtract increasing amounts of brightness as you approach the ends of the keyboard (levers are centered at nominal position). Use in conjunction with the overall BRILLIANCE control [5] to balance the timbre.

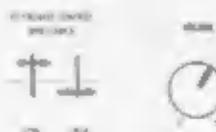
[2] **VOLUME** – This is the main volume control that sets the level of the synthesizer output. Overall volume is also affected by the rear-panel HIGH/LOW switch and the Foot Controller (Expression Pedal), as well as by inherent differences between various patches. The BRILLIANCE controls [5, 7 & 9] also affect the volume of many patches.



Pressure  
Sensitive



Moving down the Touch Response “Sub OSC” levers (VCO or VCF) is like moving down the same levers in Sub oscillator when you press hard on a key.



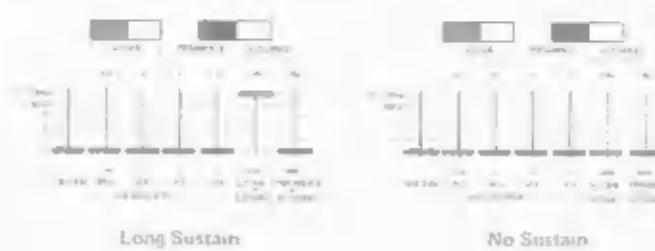
Color shows adjustment range, solid line shows actual setting.

[10] **SUSTAIN SECTION** – The SUSTAIN slider adjusts the die-away of a note after you release a key (maximum of about 10 seconds). No sustain is added if the SUSTAIN slider is moved all the way down (to SHORT).

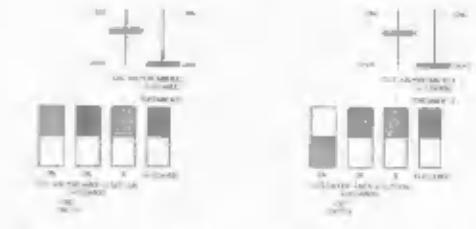
SUSTAIN 1-2 (1-1) selects the type of sustain: 1 sustains each note individually and 2 ends the sustain of previous notes each time a new note or chord is played.

The CS-60 has a SUSTAIN FOOT SWITCH assigner which, when rocked forward (ON), enables you to turn sustain ON & OFF with the Foot Switch, rocked back, sustain is always ON to the degree set with the slider. If the Foot Switch is not plugged in, sustain is always ON regardless of the assigner switch setting. (The CS-60 has no Sustain Foot Switch.)

CS-60 SUSTAIN CONTROLS



CS-60 SUSTAIN CONTROLS



#### [11] PORTAMENTO/GLISSANDO SECTION –

The PORTAMENTO/GLISSANDO (P/G) slider adjusts length of time it takes to change pitch from the previously played note or chord to the next. No effect is added if the P/G slider is moved all the way down (to SHORT).

POR**TAMENTO**/GLISSANDO changes the way the frequency moves between notes; PORTAMENTO is a continuous slide, whereas GLISSANDO is a series of discrete, half-step notes (like a chromatic scale). GLISSANDO stops when you let go of a key unless you have selected SUSTAIN 2 mode, in which case the effect continues until the note dies away.

The CS-60 has a P/G FOOT SWITCH assigner which, when rocked forward (ON), enables you to turn this effect ON & OFF with the Sustain Foot Switch, rocked back P/G is always ON. If the Foot Switch is not plugged in, P/G is always ON regardless of the assigner switch setting.

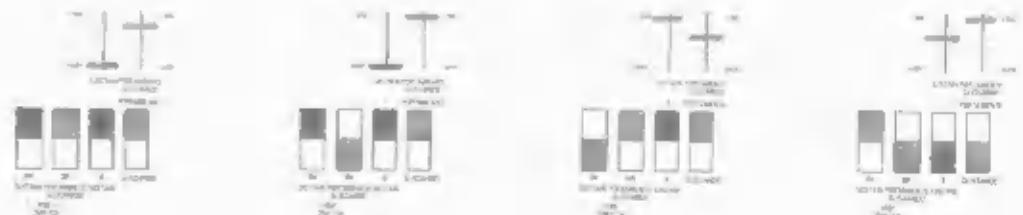
**THE KEYBOARD** – The keyboard is pressure sensitive, the specific effects depending on the setting of the TOUCH RESPONSE section [9] and the SUB OSCILLATOR section [8].

[11] **POWER** – Switches the AC power. A red light in the switch is illuminated when power is ON.

CS-60 PORTAMENTO/GLISSANDO CONTROLS



CS-60 PORTAMENTO/GLISSANDO CONTROLS



Portamento is now "ON" regardless of foot switch position. (No Sustain)

Portamento is now "ON" only when foot switch is down. (No Sustain)

Sustain now turns "ON" when foot switch is down, while Portamento remains "ON"

Glissando now turns "ON" when foot switch is down, while Sustain remains "ON". (NOTE: In II Mode, with Sustain, Glissando continues after you release the key.)